# ADWICE

## Advanced Diagnosis and Warning system for aircraft ICing Environments

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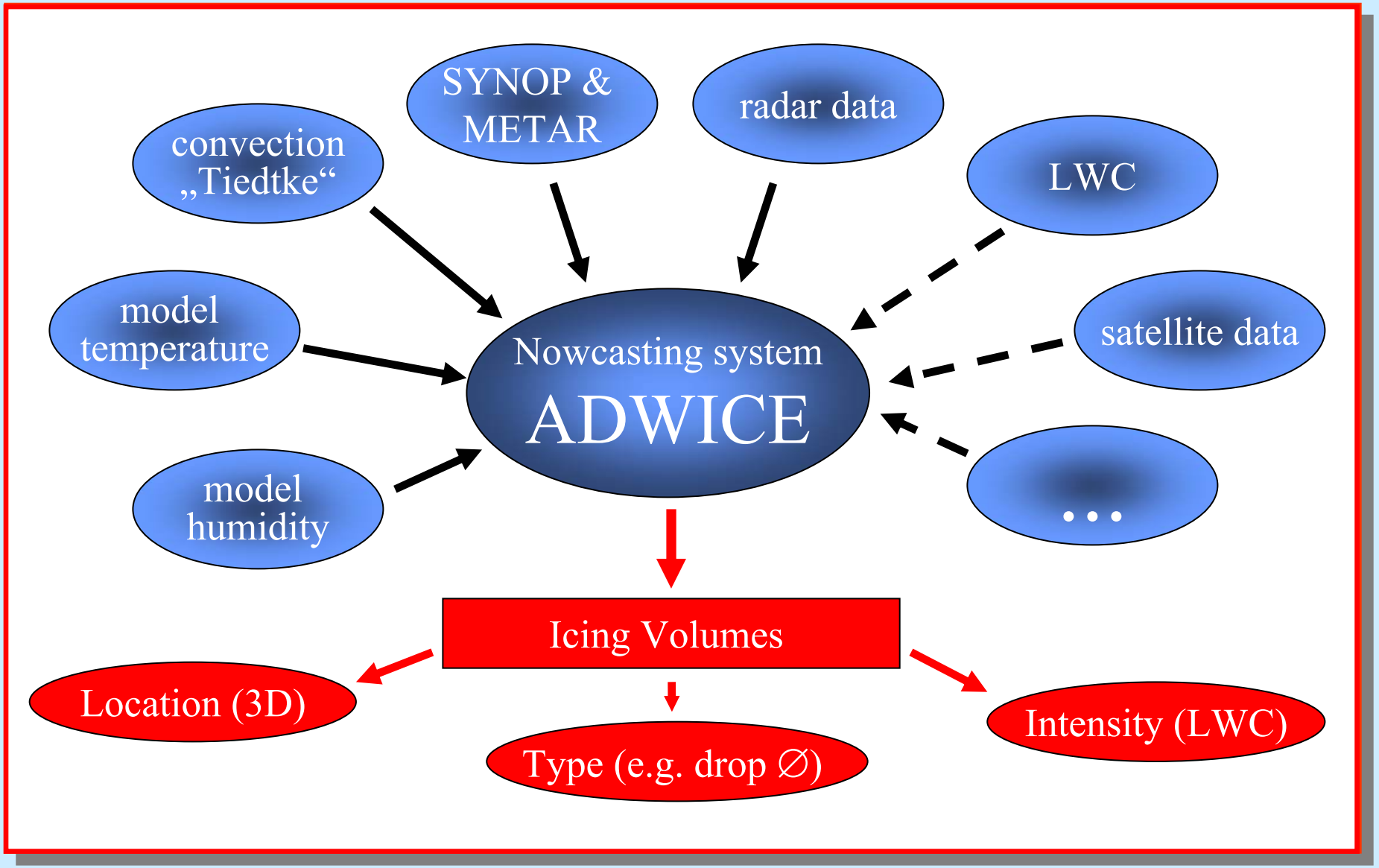
# ADWICE …

- has been developed since 1998
- in a joint co-operation between DWD, DLR and IMuK Hannover
- is based on a former NCAR-RAP algorithm (adopted for the European area, meanwhile considerably extended/changed)
- merges forecast model data with hourly observation data
- 1st version has been run pre-operationally at DWD since 2001
- 2nd version is under development at the IMuK Hannover


SYNOP & METAR
radar data
convection „Tiedtke“
LWC
model temperature
Nowcasting system
ADWICE
satellite data
model humidity
• • •
Icing Volumes
Location (3D)
Type (e.g. drop ∅)
Intensity (LWC)

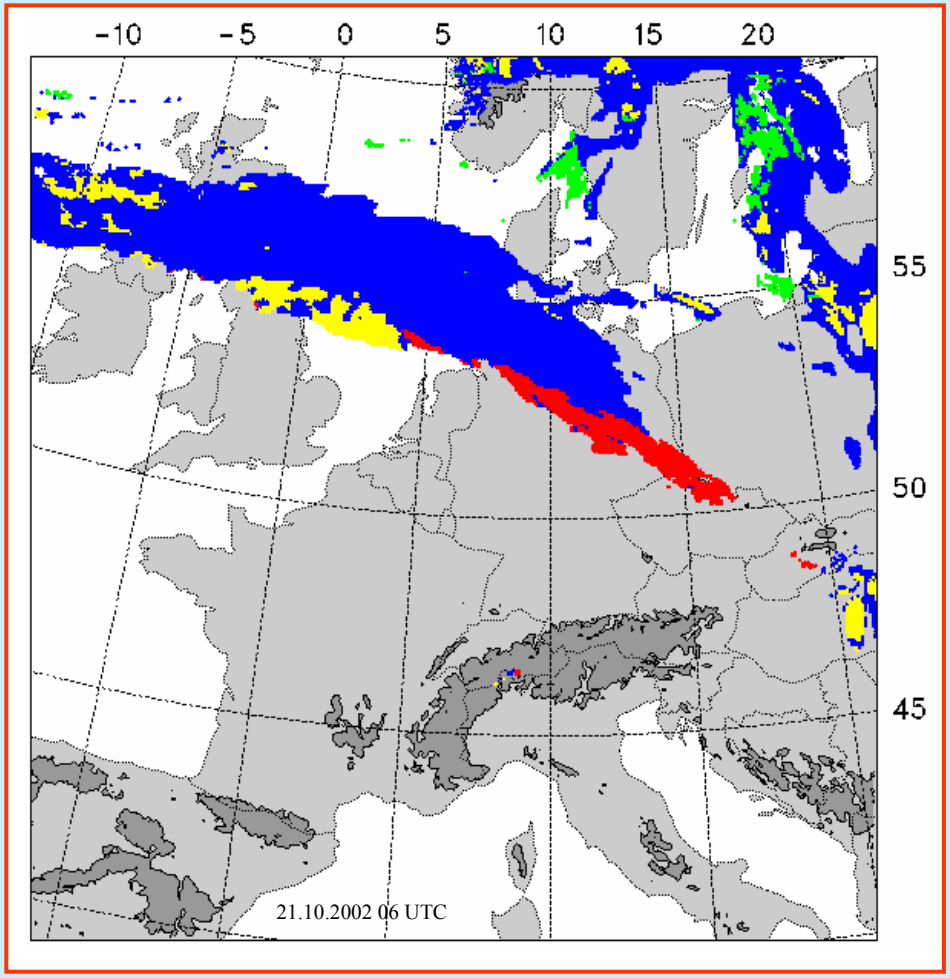
# Use of model data

## Relative Humidity, Temperature and Convection scheme data

Local Model (LM) of the German Weather Service (DWD):

- 325 x 325 grid points
- 35 vertical levels
- 7 km horizontal grid spacing

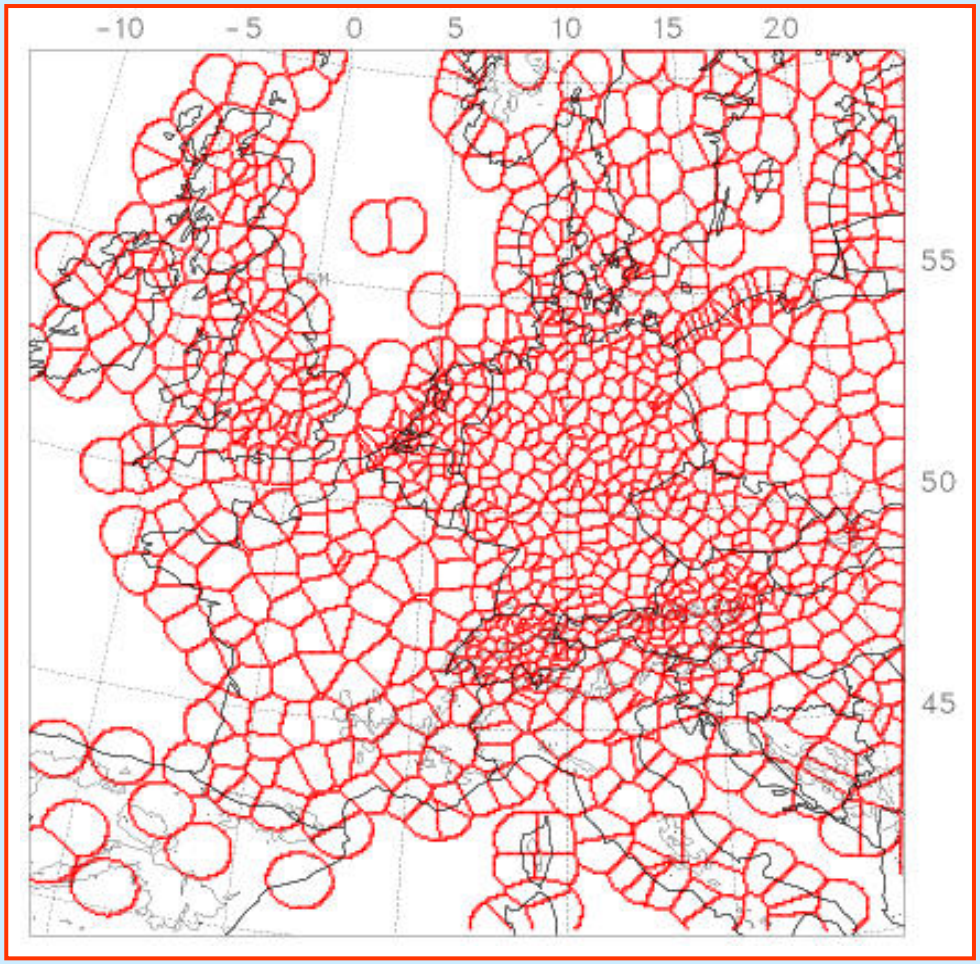
- Start 00 UTC, 12 UTC



# Use of surface observations (1)

## SYNOP and METAR

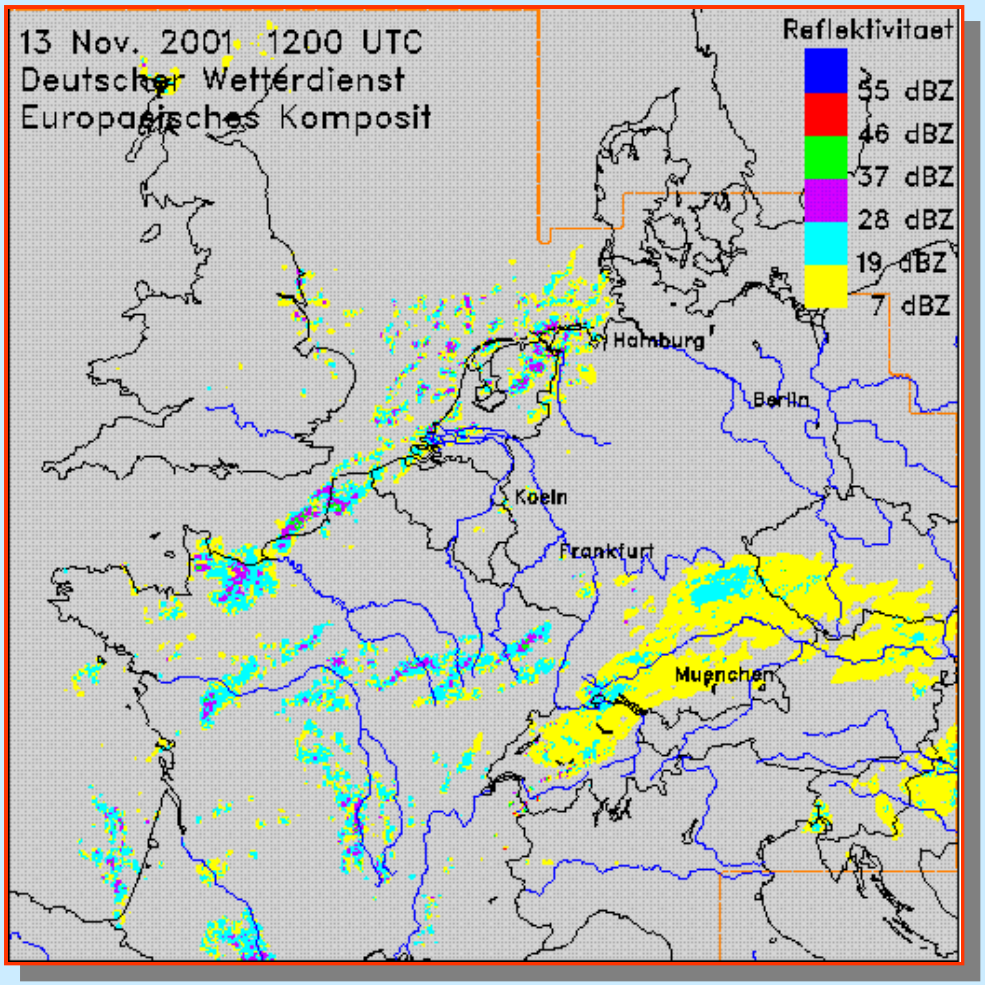
- The mean distance between grid point and reporting station is 35 km.
- Observations are related to grid points by Voronoi decomposition.
- Nearly all grid points over land get weather and cloud information from stations within a distance of 70 km.



# Use of surface observation (2)

## RADAR

- 2 x 2 km$^2$ horizontal resolution
- 16 operational radars in Germany
- plus radars from neigh-bouring countries
- composite images every quarter of an hour



# Use of further data

- Satellite images
  - at the moment only NOAA images can be used
  - satellite images from MSG (started in 2002) will be implemented into ADWICE using the applied algorithm
- LWC model data
  - current cloud models and parametrisations are optimized in respect to precipitation instead of LWC
  - new algorithms are under development at the DWD
- PIREPs etc
  - other data sources can be implemented as soon as they are validated

# ADWICE characteristics

1st step: Prognostic Icing Algorithm (PIA) → 12 hour forecast fields

2nd step: Diagnostic Icing Algorithm (DIA) → hourly diagnostic fields

- 4 different types of icing:
  freezing – stratiform – convective – general

- Icing intensity / Estimation of LWC:
  parcel method using cloud base water vapor mixing ratio

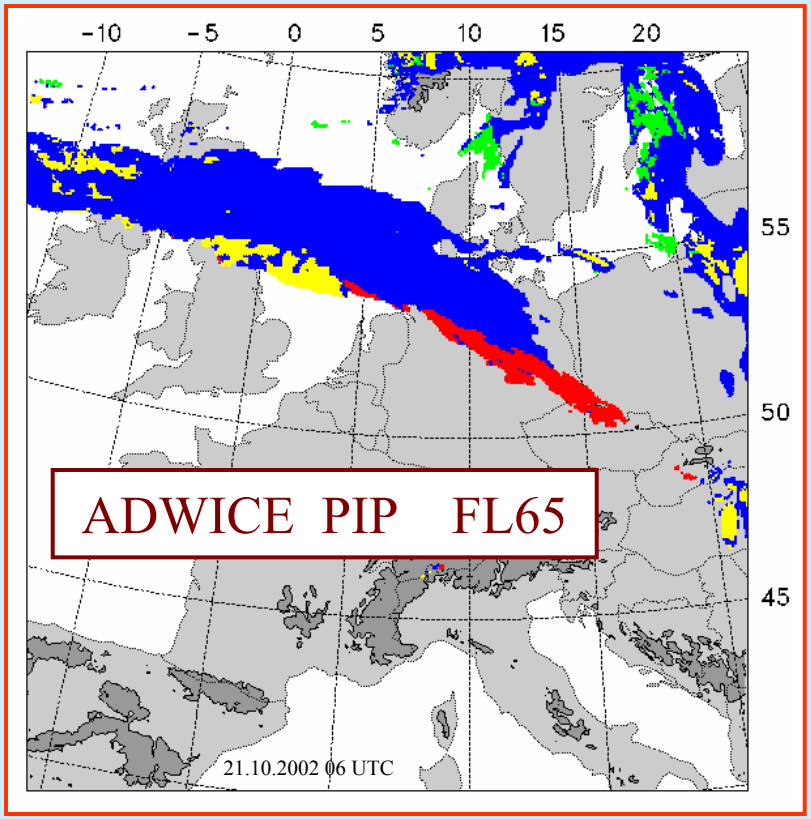
# Prognostic Icing Algorithm (ADWICE PIA)

**model data**
temperature
relative humidity
convective layer depth

Empirical algorithms determine scenarios of icing clouds of different types

freezing | convective | stratiform | general

Prognostic Icing Product (PIP)

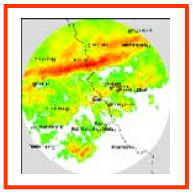


# Diagnostic Icing Algorithm (ADWICE DIA)

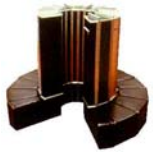
<u>observation data</u>
SYNOP/METAR, radar

\+

<u>model data</u>
T, RH, convection



Icing scenarios
(cloud/weather/icing types)



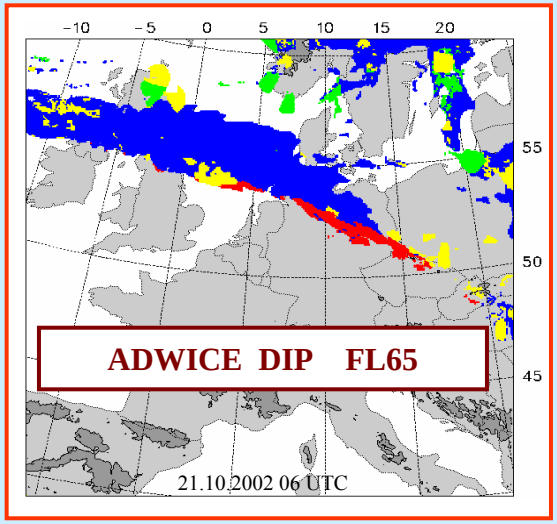
<u>ADWICE PIP</u>
for grid points with no significant surface observations

FUSION:

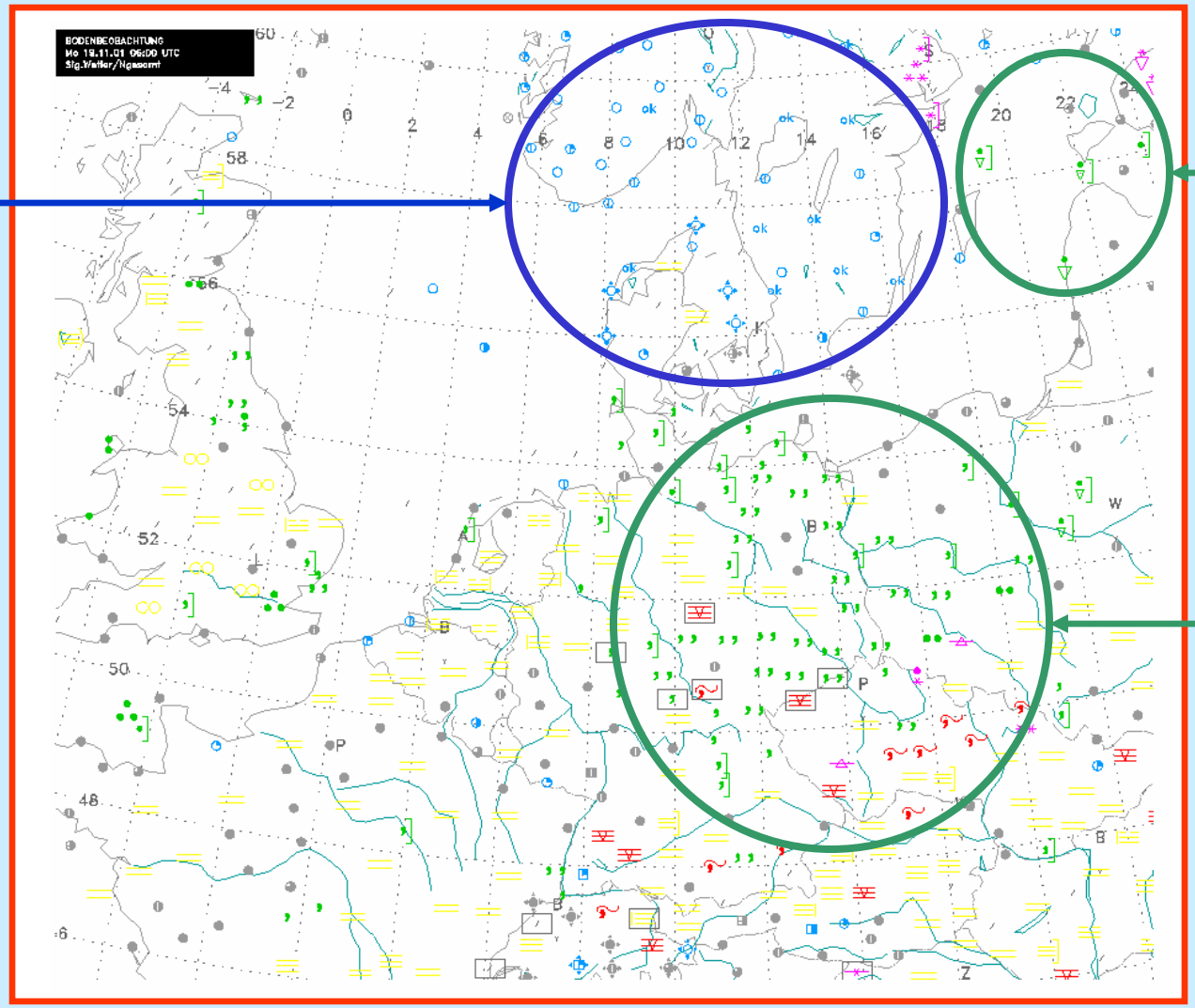
3D cloud/icing position

ADWICE Diagnostic Icing Product (DIP)

- freezing
- convective
- stratiform
- general

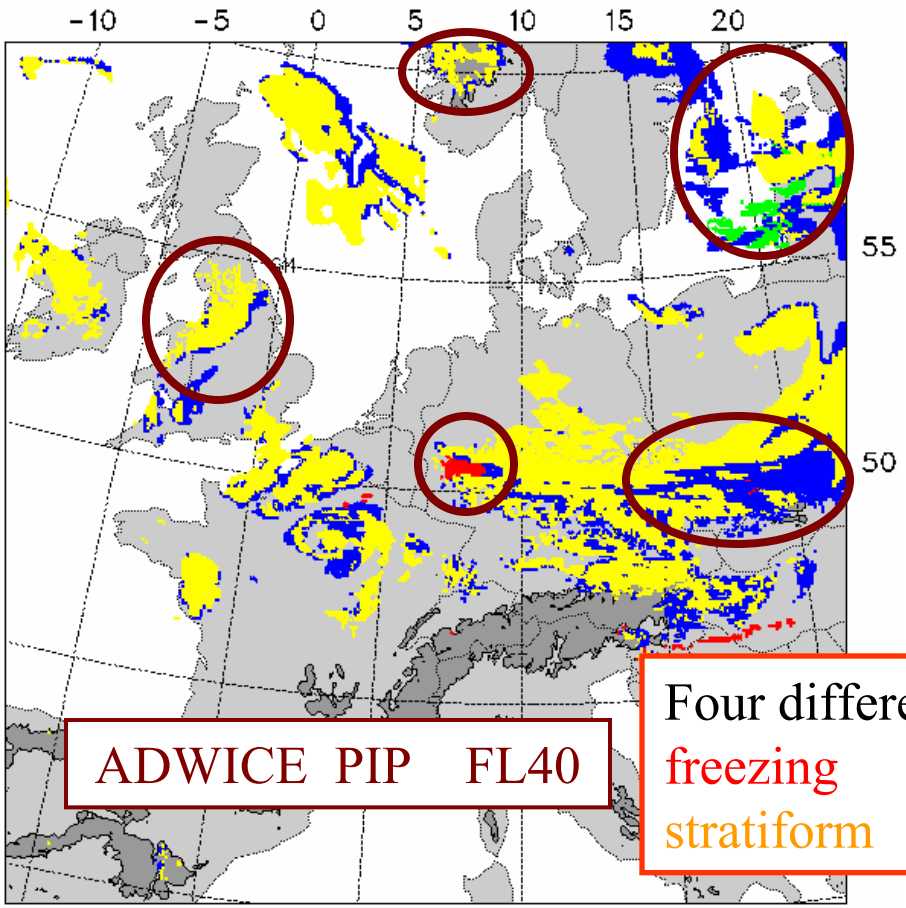


# SYNOP 19.11.2001 06UTC

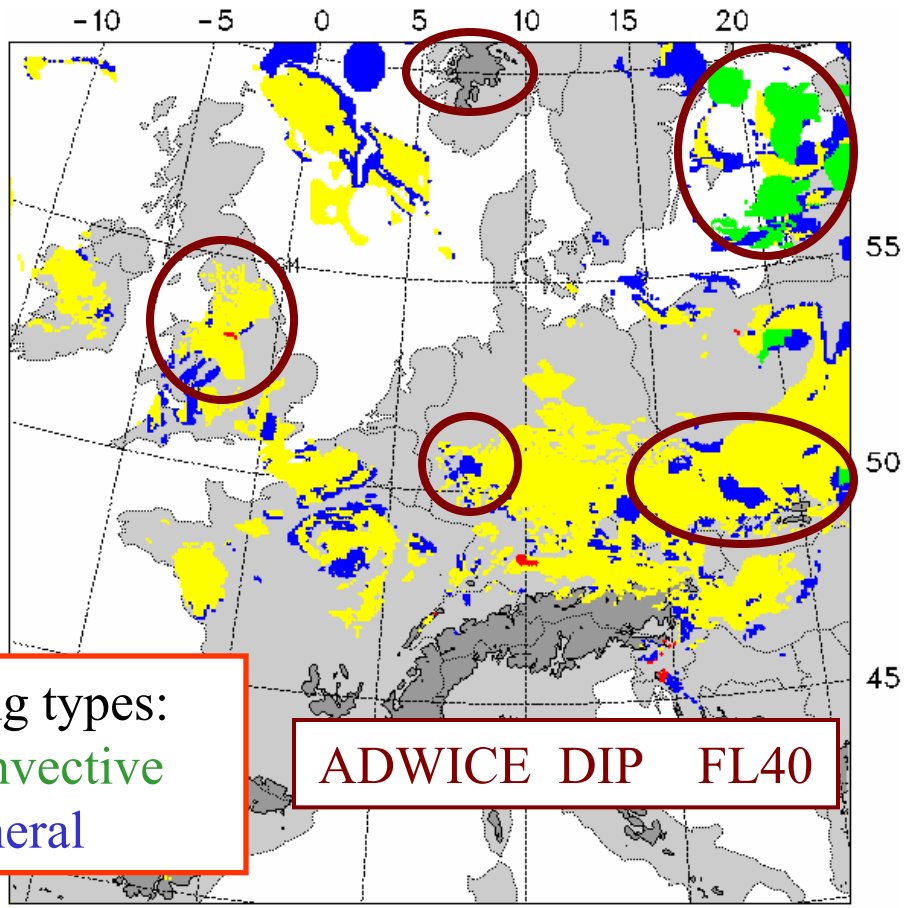



$N \leq 4$

# Icing at 19.11.2001 06UTC




ADWICE PIP FL40



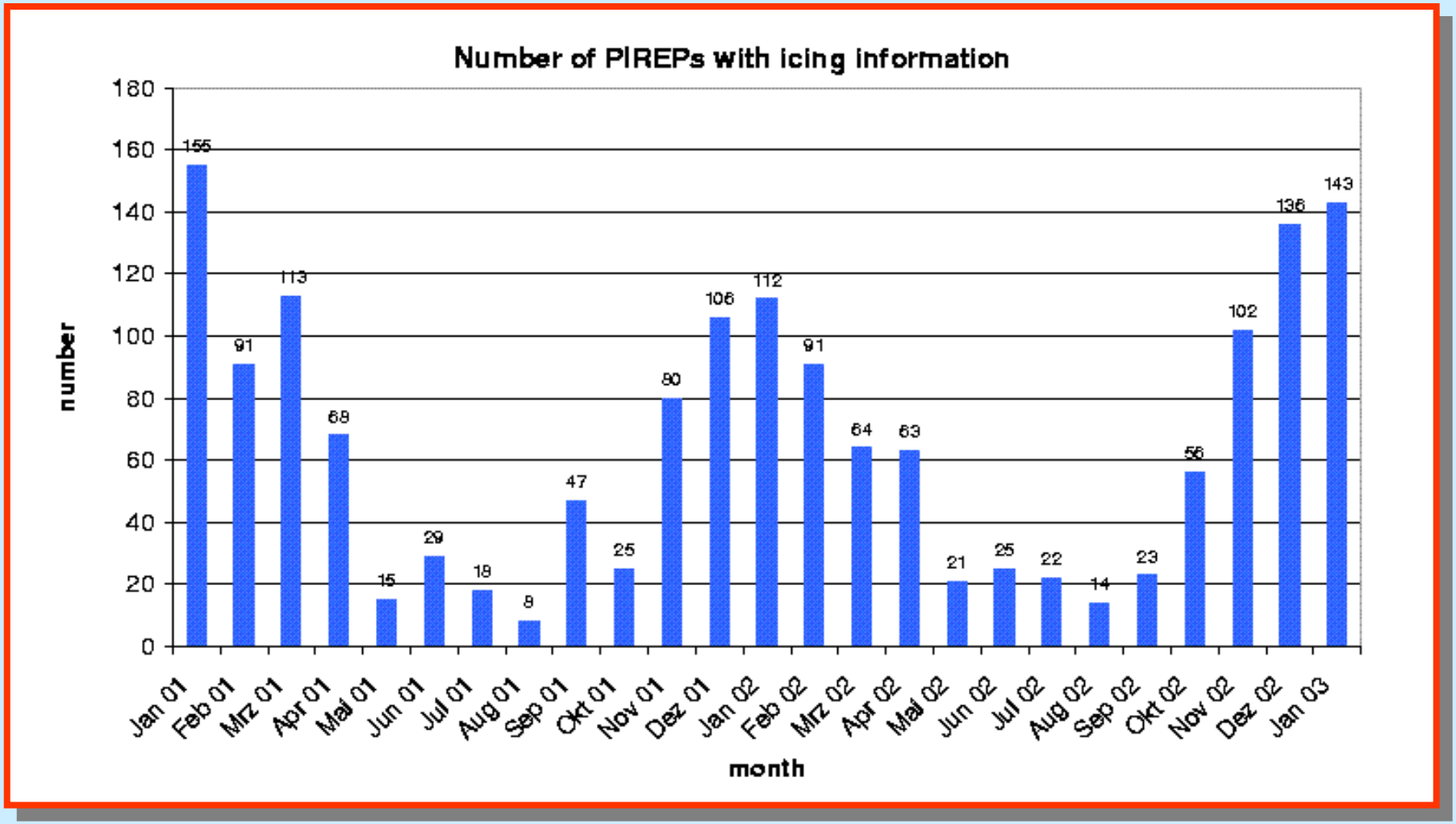

ADWICE DIP FL40

Four different icing types:

freezing convective

stratiform general

# PIREPs over Central Europe



# Methods of Validation

Currently used methods for the validation of ADWICE are:

- Case studies
- PIREPs → Probability of Detection (POD)
- Polls among pilots (e.g. Lufthansa, AeroLloyd)
- Flight deck meteorological observers
- Aircraft equipped with icing sensor (DLR´s research aircraft FALCON)

# Summary

- Currently ADWICE uses model data, SYNOP, METAR and RADAR data.
- Satellite images (MSG) and SLWC model data will improve the diagnosing and forecasting.
- Case studies show good results for diagnosed icing environments.
- For a statistical evaluation more PIREPs are needed.
- The new version (ADWICE VII) will be implemented in winter 2003/2004.

Thank you for your attention!

Danke für Ihre Aufmerksamkeit!

Je vous remercie de votre attention!

For further information see:

Tafferner et al: ADWICE – The Advanced Diagnosis and Warning system for aircraft ICing Environments; Wea. & Fore. Vol.18, No.2, April 2003